

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

EET 2066 - POWER TECHNOLOGY
(RE)

15 MARCH 2018
09.00AM – 11.00AM
(2 HOURS)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 4 pages including cover page with 3 Questions only.
2. Attempt **ALL** questions. The distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

QUESTION 1

- a) State two disadvantages of lead-acid batteries and name two types of batteries which overcome these disadvantages. (4)
- b) A robot is required to operate on a 12V, 120W DC motor. Explain how a DC power supply suitable for supplying power to the motor can be assembled using 6V, 8 AH batteries. The motor is required to run at rated full load for 8 hours before recharging. (6)
- c) A reluctance type stepper motor has 4 stator poles. Determine the number of rotor poles required to obtain a step angle of 18° for unipolar winding and bipolar winding. (5)
- d) A stepper motor has a step angle of 1.2° . It is driven at a rate of 2000 pulses/s. Determine the rotor speed in rpm and the number of pulses to be applied to rotate the rotor through 60° . (4)
- e) An NPN power BJT switching circuit with purely inductive load has the following parameters:
- $V_{CC} = 120\text{ V}$; Collector-emitter leakage current = 2 mA; Collector-emitter saturation voltage = 1.2V; On-state collector current = 25A; Switching frequency = 8 kHz; Duty cycle = 0.5; Turn-on time = 0.6 μs ; Turn-off time = 1.0 μs .
- i. Draw the circuit diagram of the switching circuit showing all parameters. (4)
- ii. Calculate the total power dissipation in the power BJT. (12)

Continued...

QUESTION 2

- a) A single phase full wave diode bridge rectifier operating from a 230V, 50 Hz supply, delivers a current of 15A to a purely resistive load. Assume ideal diodes and negligible source inductance.
- i. Draw the circuit diagram of the rectifier . (3)
 - ii. Sketch the waveforms of output voltage, output current and source current. (6)
 - iii. Calculate the average output voltage and percentage ripple. (4)
 - iv. Explain how the percentage ripple can be reduced. (2)
- b) Compare boost DC-DC converter and fly-back DC-DC converter with respect to: i. Input-output electrical isolation ii. Input - output polarity and iii. Buck operation. (3)
- c) A DC-DC boost converter operates at a switching frequency of 15 kHz and a duty cycle of 0.6. The source voltage is 10 V and load resistance is 10Ω . The inductance is 1mH and the capacitance is $220\mu\text{F}$. Assume ideal diode and switch.
- i. Draw the circuit diagram of the converter and sketch the wave-forms of inductor voltage and inductor current. (8)
 - ii. Calculate the output voltage and its percentage ripple. (4)

Continued...

QUESTION 3

- a) A single-phase 50 Hz full-bridge voltage-source inverter with a square wave output feeds power to a RL load. The DC supply voltage (V_s) is 120V. The expression for the output voltage across the load is given by

$$v(\omega t) = \sum_{n=1,3,5}^{\infty} \frac{4V_s}{n\pi} \sin n\omega t$$

- i. Draw the complete circuit diagram of the inverter and state the sequence of operation of switches. (5)
 - ii. Sketch the waveforms of load voltage, load current and fundamental component of load voltage. (6)
 - iii. Calculate the total harmonic distortion (THD) in the output voltage wave form. (4)
- b) With the help of a block diagram, explain the operation of an uninterrupted power supply (UPS). (10)
- c) Draw the steady state equivalent circuit of a permanent magnet DC motor and explain how variable speeds can be obtained by voltage control. Sketch the torque-speed characteristics with variable armature supply voltage. (10)

End of Paper